A PRELIMINARY STUDY ON PHYSIOLOGIC SPECIALIZATION IN THE ISOLATES OF *RHIZOCTONIA SOLANI* FROM KENAF

Chin-chyu Tu[1]

Abstract

Different species and varieties of kenaf, including *Hibiscus acetosella*, *H. radiatus*, *H. sabdariffa* and 7 varieties of *H. cannabinus*, were tested under greenhouse and laboratory conditions for their susceptibility to three isolates of *Rhizoctonia solani* Kühn (=*Thanatephorus cucumeris* (Frank) Donk) from kenaf seedlings. Reaction of seeds and seedlings to a given isolate varied from moderately resistant to highly susceptible. The results suggest the possibility of the existence of physiologic specialization in the isolates of *R. solani*.

Introduction

Rhizoctonia solani Kühn (=*Thanatephorus cucumeris* (Frank) Donk) consists of a heterogeneous group of strains differing in growth characteristics, pathogenicity, host range, morphology, utilization of chemicals, enzyme secretion, optimum temperature and pH requirements, and tolerance to fungicides (1, 2, 3, 4, 6). Kernkemp *et al.* (2) reviewed the literature and described physiologic specialization in *R. solani* based on their cultural characteristics. Many investigators have tried to demonstrate the physiologic specialization of *R. solani* on different crops. Fulton *et al.* (1) reported that of 650 cotton lines tested none showed resistance to *R. solani* except some cold-tolerant varieties. Teng (6) showed that 50 cotton varieties tested were equally susceptible to *Corticium solani*. Shatla and Sinclair (4) reported that the existence of physiologic specialization was observed with three isolates of *R. solani* by their parasitism on bean. Most of the work concerning with physiologic specialization in *R. solani* has been carried out *in vitro* or with crops other than kenaf (2).

A primary study was made to determine the reaction of selected varieties and species of kenaf to infection of three isolates of *R. solani* and to ascertain whether the varieties of kenaf could be used to establish physiologic specialization in the isolates of *R. solani*.

Materials and Methods

Three hyphal tip isolates of *R. solani*, 6, 15, and 27 were used in this study. They were isolated from kenaf seedlings in 1967, 1968, and 1969, respectively, and

1 Plant pathologist, Head, Department of Plant Protection, Tainan Fiber Crops Experiment Station, Tainan, Taiwan.

the cultures were maintained through serial transfers on potato-sucrose agar. Each hyphal cell of the tested isolates was observed to contain multinuclei. Kenaf varieties and species of the collection of Tainan Fiber Crops Experiment Station were used (Table 1).

The reaction of kenaf varieties and species to *R. solani* was tested in greenhouse and laboratory. In the greenhouse experiment, autoclaved soil sandy loam was infested with each of three isolates of *R. solani* by adding 20 ml of mycelial suspension to a 50 x 80 x 20 cm flat, then flooded with water to assure even distribution of inoculum. Each flat was planted with 20 rows of 10 seeds/row of each kenaf species or variety arranged in a randomized-block design. The mean percentage of seed germination was calculated each day after planting, and the healthy seedlings were counted after the appearance of first true leaves. The reaction of the seedlings to a given isolate of *R. solani* was based on the percentage of seedlings survived.

For laboratory test, 15 seeds of each species or variety were planted in a 12-cm clay pot filled with autoclaved soil, into which about 5 ml of mycelial suspension of the isolate of *R. solani* was added. Noninfested pots were served as control. Four pots were planted for each treatment. After inoculation of the isolates and planting of kenaf seeds all pots were placed in the laboratory, where the temperature fluctuated around 28±2°C and provided with 10 hr illumination. Soil moisture was kept at 20-25% m.h.c. throughout the period of experiment. Seed germination and the number of healthy seedlings of kenaf were inspected as described in the greenhouse test.

Inoculum for infesting autoclaved soil was prepared in a manner described by Shatla and Sinclair (4). *R. solani* isolated which had been grown on potato-sucrose broth at 28±2°C for 10 to 15 days were filtered and macerated in a Waring blender with 20 ml distilled water for 30 seconds.

Results

As shown in Table 1, a lower percentage of seed germination was generally observed in the laboratory test, and the isolate 15 was most virulent among the isolates. Regardless of the laboratory and greenhouse test, seed germination of *Hibiscus sabdariffa* was always affected most severely by all three isolates. Although the laboratory conditions were found to be more favorable to the development of seed rot and pre-emergence rot, the results indicated that pathogenicity of *R. solani* on kenaf seeds was inherited by the nature of isolates and by the susceptibility of the hosts.

The results summarized in Table 2 also indicated there was a significant difference in the virulence of three isolates to kenaf seedlings. The isolate 6 resulted in complete kill of kenaf seedlings or less than 20% of survival, except the seedlings of *H. acetosella* tested in the laboratory. Both of the laboratory and the greenhouse tests, *H. acetosella, H. sabdariffa*, and 7 varieties of *H. cannabinus* were found to be

Table 1. Mean percentage of seed germination of 10 kenaf species and varieties after inoculation of 3 isolates of ***Rhizoctonia solani*** (Greenhouse and laboratory tests)

Species or Variety		*Greenhouse test*			*Laboratory test*		
		Isolate			*Isolate*		
		6	15	27	6	15	27
Hibiscus acetosella		85	65	100	93	13	100
Hibiscus radiatus		85	55	100	33	13	100
Hibiscus sabdariffa		35	40	50	0	0	53
Hibiscus cannabinus	58-1	70	50	95	27	20	80
do.	58-4	90	80	90	53	37	93
do.	58-10	65	80	90	40	20	73
do.	58-44	55	80	90	46	53	86
do.	58-47	55	50	70	7	13	73
do.	58-58	65	90	100	73	53	73
do.	58-71	70	50	95	46	20	87

Table 2. Reaction of kenaf seedlings of 10 different species and varieties to 3 isolates of ***Rhizoctonia solani*** under laboratory and greenhouse conditions*

Species or Variety		*Greenhouse condition*			*Laboratory condition*		
		Isolate			*Isolate*		
		6	15	27	6	15	27
Hibiscus acetosella		8	8	4	6	8	4
Hibiscus radiatus		8	6	4	8	4	4
Hibiscus sabdariffa		8	8	4	8	8	4
Hibiscus cannabinus	58-1	8	8	4	8	8	4
do.	58-4	8	8	8	8	8	8
do.	58-10	8	8	8	8	8	8
do.	58-44	8	8	6	8	8	6
do.	58-47	8	8	8	8	8	8
do.	58-58	8	8	8	8	8	8
do.	58-71	8	8	6	8	8	6

* Reaction of seedlings was divided into 4 classes based on the percentage of seedlings survived. 2=81-100%, 4=51-80%, 6=21-50%, 8=0-20%.

susceptible to the isolate 15, while *H. radiatus* were found to be resistant under laboratory condition. All of the varieties of *H. cannabinus* but 58-1 were found to be susceptible or highly susceptible to the isolate 27.

Discussion

The results presented in this paper suggest the presence of physiologic specialization in *R. solani* based on the host reaction to the isolates of this fungus. Stakman and Christensen (5) stated that the identification of physiological races of a pathogen, such as *R. solani*, is very difficult because the criterion for evaluation is the percentage of plants killed and there is always a great variance in this quantitative character. In this study, however, reaction of different species or varieties of kenaf to *R. solani* was entirely determined by virulence of three isolates, which had been maintained on potato-sucrose agar medium. Among the isolates tested, seed germination of kenaf species or varieties was extremely damaged by the isolate 15 under laboratory conditions (Table 1). Kenaf seedlings susceptible to the isolates 6 and 15 were, on the other hand, found to have considerable degree of resistance against the isolate 27 (Table 2). These results evidently indicate that there exists some extent of physiologic specialization in the isolates of *R. solani*.

It was also found that some kenaf species and varieties seemed to have enough resistance to the isolates of *R. solani*. and could be used in a breeding program. However, it is only applicable when the physiologic specialization in *R. solani*. is much more clarified.

Acknowledgments

The author wishes to acknowledge the kindness of Mr. Hsing-chao Liu, Agronomist of the Station, for supplying seeds of kenaf varieties and species. Thanks are also due to Mr. T. T. Lo of the Joint Commission on Rural Reconstruction for critical review of this manuscript. This work was supported by the Joint Commission on Rural Reconstruction.

References

1. Fulton, N. D., B. A. Waddle, and K. Bollenbacher. 1962. Varietal resistance to seedling disease in cotton. Phytopathology 52 : 10. (Abstr.)
2. Kernkemp, M. F., D. J. Dezeeuw, S. M. Chen, B. C. Ortega, C. T. Tsiang, and A. M. Khan. 1952. Investigation on physiologic specialization and parasitism of *Rhizoctonia solani*. Minnesota Agr. Exp. Sta. Tech. Bull. 200. 36pp.
3. LeClerg, E. L. 1939. Methods of determination of physiologic races of *Rhizoctonia solani* on the basis of parasitism on several crop plants. Phytopathology 29 : 609–616.
4. Shatla, M. N., and J. B. Sinclair. 1965. *Rhizoctonia solani*: Physiologic specialization among isolates from cotton. Plant Dis. Reptr. 49:711–714.
5. Stakman, E. C., and J. J. Christensen. 1960. The problem of breeding resistant varieties. Vol. 3. pp. 567–624. *In* J. G. Horsfall, and A. E. Dimond. (eds.). Plant

pathology. Academic Press, New York.
6. Teng, S. C. 1931. A preliminary report on the studies of certain diseases of cotton. Contrib. Biol. Lab. Sci. Soc. China. Bot. Ser. 6:117-134. (Rev. Appl. Mycol. 2:298. 1932)

鐘麻腰折病病原菌（*Rhizoctonia solani*）菌株間生理分化之初步研究

杜 金 池

本研究分別在實驗室及溫室測定 10 種不同品種之鐘麻（包括 *Hibiscus cannabinus* 7 品種，*H. acetosella*，*H. radiatus*，及*H. sabdariffa* 各 1 品種）對自鐘麻分離之 *Rhizoctonia solani* 菌株之感受性。鐘麻幼苗或種子對 *R. solani* 之感病性因病原菌菌株及鐘麻品種之不同而有差異其反應自極感病至中等抗病。根據此項事實，筆者認爲侵害鐘麻之 *R. solani* 菌株間可能有不同生理型存在，惟須更進一步之探討與試驗。